

16 March 1971

Matériel Test Procedure 6-3-125
U. S. Army Airborne, Electronics
and Special Warfare Board

3442

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

IFF EQUIPMENT, GROUND-TO-GROUND

1. OBJECTIVE

This document is a guide to test methods and techniques for determining the suitability of IFF equipment for use by the Army in determination of the friendly or enemy character of tactical elements and other potential targets on the ground.

2. BACKGROUND

Identification friend or foe (IFF) is defined as a system using electronic transmissions (interrogations) to which equipment carried by friendly forces automatically responds thus distinguishing the friendly forces from enemy forces. The need for IFF capability within the ground combat environment has been widely acknowledged and multiple approaches to development of equipment to fulfill the need have been used. The most common approaches have included: use of interrogator-responder/transponder systems used either in conjunction with combat surveillance radar sets or as separate systems; and use of relatively simple beacon equipment (transponder) operating directly with and on the same frequency as a particular combat surveillance radar set. In either approach the transponder and beacon items may be designed for use on ground vehicles as well as for man-pack use, and interrogator-responder items may be used stationary on the ground, mobile on ground vehicles, and mobile in aircraft. As IFF equipment becomes available, service testing is required for determining its suitability for Army use. Procedures for conduct of such testing are presented in this MTP.

3. REQUIRED EQUIPMENT

- a. IFF Equipment under test (test item).
- b. Equipment or systems with which the test item is designed and/or required to operate together with test equipment and tools required for use of such equipment and systems.
- c. Maintenance test package (ref 4.S).
- d. Suitable field test sites.
- e. Equipment and facilities specified in referenced MTP's.

4. REFERENCES

- A. USATECOM Regulation 70-23, Research and Development: Equipment Performance Reports (EPRs).
- B. USATECOM Regulation 70-24, Research and Development: Documenting Test Plans and Reports.
- C. USATECOM Regulation 700-1, Quality Assurance: Value Engineering.

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- D. MTP 6-3-500, Physical Characteristics.
- E. MTP 6-3-501, Pretest Inspection.
- F. MTP 6-3-502, Personnel Training Requirements.
- G. MTP 6-3-504, Installation and Operation.
- H. MTP 6-3-506, Durability.
- I. MTP 6-3-508, Submersion.
- J. MTP 6-3-509, Effects of Weather.
- K. MTP 6-3-510, Transportability of Communications, Surveillance and Electronic Equipment.
- L. MTP 6-3-512, Compatibility with Related Equipment.
- M. MTP 6-3-513, Qualitative Electromagnetic Interference.
- N. MTP 6-3-514, Qualitative Frequency Accuracy and Stability.
- O. MTP 6-3-516, Remote Operation.
- P. MTP 6-3-517, Electrical Power Requirements.
- Q. MTP 6-3-518, Operation During Travel.
- R. MTP 6-3-523, Safety.
- S. MTP 6-3-524, Maintenance.
- T. MTP 6-3-525, Human Factors.
- U. QMR, SDR or other approved requirements.
- V. Technical Manuals, Manufacturer's Installation, Operation, and Maintenance Information and Appropriate Engineering Test Data.

5. SCOPE

This materiel test procedure describes test for determining the suitability of the test item to recognize the friendly elements from among all elements detected. The test item will be installed and operated under field conditions by personnel representative of those who will operate the equipment when it is fielded. It will be operated in conjunction with types of surveillance equipment in current use under various conditions of visibility. The test item and its performance will be compared with the requirements of applicable QMR, SDR or other approved documents. When the test item is intended to replace one or more standard items, the standard items (referred to as control item(s)) shall be subjected to the applicable test procedures concurrently with the test item to develop the relative merits of each.

5.1 SUMMARY

5.1.1 Preparation for Test

This section provides guidance for test project planning, requirements for facilities and equipment, and instructions for test personnel familiarization.

5.1.2 Test Conduct

The specific tests to be performed are as follows:

a. Physical Characteristics and Test Item Inspection - This section provides procedures for obtaining test item physical characteristics and determining condition of the test item as received for test.

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b. Personnel Training - Procedures are given for training test personnel in installation and operation of the test items as well as operator maintenance functions.

c. Installation and Operation - Installation and operation are accomplished by representative user personnel and repeated as necessary to determine time, personnel and tools required.

d. Electrical Power Requirements - The objective of this subtest is to determine power requirements for the test item.

e. Compatibility - Procedures are given for determining any lack of compatibility between the test item and equipment with which it is designed and/or required to operate.

f. Tactical Operation - Procedures are given for determining IFF performance under line-of-sight, defilade, and concealing foliage conditions. Included also are procedures for determining any antenna directional effects and test item performance compared to performance of any associated surveillance equipment.

g. Qualitative Electromagnetic Interference - The objective of this subtest is to evaluate the interference caused by the operation of collocated equipment to the test item and the interference caused by the test item to collocated equipment in the system operating environment.

h. Qualitative Frequency Accuracy and Stability - The objective of this subtest is to evaluate the capability of the test item to maintain accurate and stable operating frequencies under field conditions.

i. Transportability of Communications, Surveillance, and Electronic Equipment - The objective of this subtest is to evaluate the provisions for transport of the test item and the effect resulting from air, surface, and man transport as specified.

j. Remote Operation - The objective of this subtest is to evaluate the capabilities of the test item for remote operation with remote control equipment.

k. Submersion - The objective of this subtest is to determine if the test item is immersion proof.

l. Operation During Travel - The procedures given are for determining significant performance differences between stationary operation and operation while traveling.

m. Durability - This section contains procedures for determining capability of the test item to withstand the effects of handling and transporting under field conditions.

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n. Weather - A determination of the effects of weather on the test item is made based on weather conditions encountered.

o. Maintenance - Throughout the conduct of all testing, maintenance actions are noted and reported. This includes all failures, manpower, tools and equipment required, suitability of maintenance instructions and the maintenance test package, mean time between failures and mean time to repair.

p. Human Factors - An evaluation of the man item relationship under the prescribed test conditions to determine the ease of handling, operating, and maintaining the test item.

q. Value Analysis - An evaluation directed at analyzing components and features for the purpose of reducing cost without compromising its performance, safety, and suitability for Army use.

r. Safety - An evaluation to determine the safety characteristics and to provide safety confirmation.

NOTE: Any Electronic Warfare Susceptibility Subtest required are the responsibility of the Army Security Agency. Electronic Warfare RDTE functions are specified in AR 10-122 and AR 105-87.

5.1.3 Test Data

This section details the raw data to be collected and recorded while completing the test procedures in paragraph 6.2, Test Conduct.

5.1.4 Data Reduction and Presentation

This section provides instructions for analyzing and evaluating the raw data and presenting the results.

5.2 LIMITATIONS

This document contains procedures for service testing of IFF equipment intended for use in a ground combat environment. It excludes testing of IFF equipment associated with air defense.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Test Project Planning

The test project officer and other designated test personnel must:

a. Review the test directive to gain a clear understanding of test objectives and all accompanying instructions.

b. Conduct a thorough study of stated requirements as contained in QMR, SDRs, the Test Directive, or other appropriate documents to insure that complete and suitable test criteria are selected.

c. Study thoroughly the characteristics of the test item and associated electronic equipment intended to be used with it.

d. Determine test site and frequency requirements.

e. Plan for and schedule all test personnel and any personnel training required.

f. Review the listing of required equipment (paragraph 3) and data determined in paragraph 6.1.1c to determine support items required.

6.1.2 Required Equipment/Facilities Setup

Test projects conducted at the established test facilities will normally require minimum preparation with respect to equipment and facilities setup. Support items required are usually readily available but scheduling and planning for use are required.

6.1.3 Test Personnel Training and Familiarization

Instruct supervisory test team members in the safety precautions to be followed when conducting tests. Issue copies of all appropriate technical manuals for equipment used during testing. Include the following:

a. Information on proper use of electronic equipment operated with the test item.

b. Procedures to be followed and the data to be collected during test conduct.

c. Known hazards and safety precautions associated with test procedures and equipment.

6.2 TEST CONDUCT

Subtests shall be conducted concurrently with other subtests, whenever possible, so that time to collect required data can be minimized.

NOTE: All test item damage either noted upon receipt or sustained during testing shall be reported in accordance with USATECOM Regulation 70-23 (ref 4.A).

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6.2.1 Physical Characteristics and Test Item Inspection

Determine the physical characteristics and the physical and operational condition of the test item as received for test using applicable portions of MTP 6-3-500 (ref 4.D) and MTP 6-3-501 (ref 4.E).

6.2.2 Personnel Training

Using applicable procedures in MTP 6-3-502 (ref 4.F), conduct operator training. Instruct test personnel in the tactical installation, operator maintenance.

6.2.3 Installation and Operation

Perform applicable portions of MTP 6-3-504 (ref 4.G) to determine the ease of tactical installation and operation of the test item.

6.2.4 Electrical Power Requirements

Using applicable portions of MTP 6-3-517 (ref 4.P) determine suitability of the test item for use with power sources as may be designated in the QMR or SDR, and for use with representative tactical power sources.

6.2.5 Compatibility

Perform applicable portions of MTP 6-3-512 (ref 4.L) to determine any lack of electrical and mechanical compatibility that may exist between the test item and equipment with which it is required to operate. This includes but is not necessarily limited to compatibility in terms of size, weight, electrical cables and connectors, code format, code rate, signal levels, and recognition data presentation.

6.2.6 Tactical Operation

a. Under field conditions and in areas having line-of-sight, near line-of-sight to various degrees, and wooded terrain conditions, install the test item to operate either alone and/or with designated surveillance equipment as required. This includes the interrogator-responder item, if one is involved, and the transponder item mounted on designated vehicles and in man-pack configurations as intended by design and/or as required.

b. Position the transponder item at line-of-sight distances, in turn, from the minimum to the maximum as specified in the QMR or SDR and/or as rated by design. Operate the interrogator-responder (or associated surveillance item as appropriate) to interrogate the transponder. During interrogation, rotate the interrogator-responder antenna throughout an azimuth of 360° and note all antenna directions where proper responses (replies), incorrect responses, and no responses are received. Increase distance beyond the required and/or rated to determine a maximum for reliable operation.

c. During conduct of the procedure in paragraph 6.2.6.b., and at each distance used, orient the interrogator-responder antenna directly toward the transponder for reception of proper responses. Rotate the transponder antenna throughout an azimuth of 360° (if the transponder is mounted on a vehicle, this would mean rotation of the vehicle itself; if the transponder is man-pack operable, rotation of the man will be required). Note all directions of transponder orientation where correct, incorrect, and no responses are received.

d. At short, intermediate, and maximum distances (maximum as determined during conduct of procedures in paragraphs 6.2.6.b. and c.), select locations for transponder operation that impose various conditions, separately, of defilade and concealing woods foliage. Interrogate the transponder using the best antennas orientation as determined previously. Note the extent of defilade (most adverse) and the maximum distance within woods where correct responses can be received.

e. Throughout the conduct of testing under field conditions, all codes and coding functions (or modes) provided must be thoroughly exercised. Codes provided from test item to test item may range from very simple pulse(s) formats to very complex multiple pulse formats that may be crypto-secure. Generally, as code formats become more complex, proper operation becomes increasingly dependent on direct line-of-sight signal propagation. Therefore, to completely determine conditions where proper responses may not be obtained, operating sites must be selected and used that offer multi-path signal propagation conditions, i.e., where the signal is transmitted and received both over a direct path and, simultaneously, over one or more indirect paths where one or more signal reflections (and attendant delays) can occur. Typically, terrain where multi-path conditions are offered would include moderate to severe hills and valleys or large buildings such as in cities. Where improper responses are obtained during such operation, the terrain conditions and test item locations must be noted in detail.

f. Where the test item is operated in conjunction with a combat surveillance item, the surveillance item must be operated to perform its designated mission. For every target detected, the test item must be used to perform the IFF function to determine that test item capability (in terms of distance, defilade, foliage penetration and other field conditions) is at least as good as that of the surveillance item with which it is used.

6.2.7 Qualitative Electromagnetic Interference

Operate test item with collocated equipment as described in applicable section of MTP 6-3-513 (ref 4.M) to determine effects of any objectionable electromagnetic interference.

6.2.8 Qualitative Frequency Accuracy and Stability

Perform the applicable procedures of MTP 6-3-514 (ref 4.N) to determine the accuracy and stability of the test item frequency or frequencies under field conditions.

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6.2.9 Transportability of Communications, Surveillance, and Electronic Equipment

Determine the transportability of the test item as described by the applicable sections of MTP 6-3-510 (ref 4.K).

6.2.10 Remote Operation

If remote operation capability is provided, determine the remote operational characteristics of the test item as described in the applicable procedures of MTP 6-3-516 (ref 4.O).

6.2.11 Submersion

Determine the immersionproof characteristics of the test item, if applicable, according to the procedures of MTP 6-3-508 (ref 4.I).

6.2.12 Operation During Travel

If required, perform applicable portions of MTP 6-3-518 (ref 4.Q) to determine performance of the test item during operation while mobile. This performance will be compared with that obtained during operation while stationary. Each operational mode provided in the test item will be used during travel over unimproved roads, trails and cross country terrain.

6.2.13 Durability

Perform applicable portions of MTP 6-3-506 (ref 4.H) in order to determine if the test item has the requisite durability. Perform tactical installation (preparation for operation) and preparation for movement actions a sufficient number of times, and accumulate a sufficient number of hours (several hundred) of operations, to simulate extended life usage.

6.2.14 Effects of Weather

Perform applicable portions of MTP 6-3-509 (ref 4.J) to determine the effects of weather encountered during the test period. Within limitations of stated requirements take advantage of every opportunity to subject the test item to weather extremes occurring during the test period.

6.2.15 Maintenance

Conduct maintenance evaluation using applicable guidance as outlined in MTP 6-3-524 (ref 4.S).

6.2.16 Human Factors

Conduct the human factors evaluation using applicable guidance as outlined in MTP 6-3-525 (ref 4.T).

6.2.17 Value Analysis

a. During the conduct of all tests, test personnel shall evaluate the test item(s) from a value versus cost standpoint. Record all pertinent comments concerning features or components which can be eliminated or modified to accomplish cost reduction without impairment of performance, reliability, quality, maintainability, or safety. The applicable portions of USATECOM Regulation 700-1 (ref 4.C) shall be used for this evaluation.

b. Consideration shall be given to the following:

1) Mission Capacity

The test item(s) should be capable of accomplishing the specified task with only a reasonable margin of excess capability. Excess capacity and unused capability normally result in unnecessary bulk, excessive weight and unwarranted costs.

2) Simplicity

Unnecessarily complex components and systems, redundancy, and the use of unneeded parts will increase costs and maintenance efforts.

3) State of the Art

In many instances the use of recently developed, currently available, components and automated features will result in an overall product improvement and cost savings.

4) Standardization

The use of identical parts and parts currently in the military system will reduce the overall logistics burden.

5) Materials and Methods of Construction

Polished surfaces, overdone finishes, and the use of expensive materials will result in unnecessary costs if used inappropriately.

6) Tolerances

Excessively close tolerances are costly and result in difficulties and delays in accomplishing assembly, routine maintenance, servicing and repair.

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6.2.18 Safety

Conduct the safety evaluation using applicable guidance as outlined in MTP 6-3-523 (ref 4.R).

6.3 TEST DATA

NOTE: In compiling the Test Data section, test personnel should expound upon that data which is other than quantitative in nature by recording narrative descriptions of events occurring during conduct of the test.

Record the following:

6.3.1 Physical Characteristics and Test Item Inspection.

Data required by MTP 6-3-500 (ref 4.D) and MTP 6-3-501 (ref 4.E).

6.3.2 Personnel Training

Data required by MTP 6-3-502 (ref 4.P).

6.3.3 Installation and Operation

Data required by MTP 6-3-504 (ref 4.G).

6.3.4 Electrical Power Requirements

Data required by MTP 6-3-517 (ref 4.P).

6.3.5 Compatibility

Data required by MTP 6-3-512 (ref 4.L).

6.6.6 Tactical Operation

a. All equipment items used and the configurations in which they were used. Include equipment nomenclature, serial numbers, and types as appropriate.

b. Description of all test sites to include terrain used. Use photographs, maps and profile charts as required to show hills, valleys, extent of defilade and woods (foliage) density.

c. Azimuth angles for both the interrogator-responder and transponder antennas throughout which correct responses, incorrect responses, and no response were received. All angles representing main lobe and any side or back lobe responses encountered must be included and shown in terms of distance, if significant variation as a function of distance was encountered.

d. The minimum and maximum distances for satisfactory IFF operation together with terrain conditions under which such distances were obtained.

e. The extent of defilade and depth of woods for satisfactory IFF performance.

f. All instances where incorrect or no responses were obtained attributable to multi-path signal propagation conditions.

g. All instances where performance of the test item failed to be equal to that of surveillance equipment with which it was used (i.e., where targets were detected and located both could not be identified due to lack of test item capability).

h. The accumulated total number of identification (interrogation) attempts made and the corresponding number of these attempts that were successful.

6.3.7 Qualitative Electromagnetic Interference

Data required by MTP 6-3-513 (ref 4.M).

6.3.8 Qualitative Frequency Accuracy and Stability

Data required by MTP 6-3-514 (ref 4.N).

6.3.9 Transportability of Communications, Surveillance, and Electronic Equipment

Data required by MTP 6-3-510 (ref 4.K).

6.3.10 Remote Operation

Data required by MTP 6-3-516 (ref 4.O), as appropriate.

6.3.11 Submersion

Data required by MTP 6-3-508 (ref 4.I), as appropriate.

6.3.12 Operation During Travel

Data required by MTP 6-3-518 (ref 4.Q).

6.3.13 Durability

Data required by MTP 6-3-506 (ref 4.H).

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6.3.14 Effects of Weather

Data required by MTP 6-3-509 (ref 4.J).

6.3.15 Maintenance

Data required by MTP 6-3-524 (ref 4.S).

6.3.16 Human Factors

Data required by MTP 6-3-525 (ref 4.T).

6.3.17 Value Analysis

a. Appropriate comments for each of the topics listed below:

- 1) Mission capacity.
- 2) Simplicity.
- 3) State of the Art.
- 4) Standardization.
- 5) Materials and methods of construction.
- 6) Tolerances.

b. Proposals for changes in the test item with reasons therefore.

6.3.18 Safety

Data required by MTP 6-3-523 (ref 4.R).

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Data Reduction

Organize, analyze and summarize all raw data as specified in each of the MTP's referred to in paragraph 6.2. Use tabulations and charts as appropriate. Make a succinct, unbiased, and independent analysis of test data to show:

a. The degree to which the test item meets stated requirements (test criteria) in QMR's, SDR's or other approved documents.

b. Deficiencies, shortcomings and suggested improvements.

6.4.2 Data Presentation

Evaluate and present a complete data summary indicating the results and address the following:

a. Item characteristics such as performance, reliability, durability and human factors engineering.

b. Comparison of test item characteristics with those of a similar item or standard (control item). Show whether the test item offers a significant improvement (or not) over the control item or only a minimal and perhaps costly improvement.

c. Maintenance and maintainability characteristics.

d. Safety characteristics and safety confirmation. All aspects of safety must be evaluated to determine if safety confirmation can be given or must be withheld pending correction of any hazards found.

e. A brief study and discussion on implications of storage, distribution, and use of crypto materiel down to and including the lowest tactical unit level where the test item is intended for use. Include this study and discussion only if the test item is designed to provide crypto-secure operation.

f. Conclusions and recommendations on overall test objectives and the suitability or unsuitability of the test item for Army use.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) U.S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
		2b. GROUP -----	
3. REPORT TITLE U.S. Army Test and Evaluation Command Materiel Test Procedure Commodity Service Test Procedure "IFF Equipment, Ground-To-Ground"			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final			
5. AUTHOR(S) (First name, middle initial, last name) -----			
6. REPORT DATE 16 March 1971		7a. TOTAL NO. OF PAGES 15	7b. NO. OF REFS 22
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S) MTP 6-3-125	
b. PROJECT NO. AMCR 310-6		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) -----	
c.			
d.			
10. DISTRIBUTION STATEMENT Distribution of this document is unlimited.			
11. SUPPLEMENTARY NOTES -----		12. SPONSORING MILITARY ACTIVITY Headquarters U.S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
13. ABSTRACT Procedures are prescribed for service testing IFF equipment intended for use in a ground combat environment. Air defense IFF are excluded.			

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Identification Electronic Warfare						

UNCLASSIFIED